GREATER TORONTO AREA
URBAN STRUCTURE CONCEPTS STUDY

BACKGROUND REPORT NO. 4
WATER, SEWERS AND SOLID WASTE

Prepared for
The Greater Toronto Coordinating Committee

IBI GROUP
in association with
R.V. ANDERSON ASSOCIATES LIMITED
MACVIRO CONSULTANTS INC.
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JUNE, 1990

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June 8, 1990

Mr. E. M. Fleming
Chairman
Greater Toronto Coordinating Committee
5 Park Home Avenue
Suite 210
North York, Ontario
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Dear Mr. Fleming:

Background Paper No. 4: Water, Sewers and Solid Waste

This is the fourth in a series of background reports for the GTA Urban Structure Concepts Study. The background reports in the series are as follows:

1. Description of Urban Structure Concepts
2. The GTA "No-Growth" Option
3. Transportation Systems
4. Water, Sewer and Solid Waste
5. Greening/Environment
6. Human Services
7. Comparison of Urban Structure Concepts

The overall study results are presented in a separate report titled GTA Urban Structure Concepts Study: Summary Report.

This background report describes the comparison of hard services for the three urban structure concepts. The hard services include the trunk water and sanitary sewerage systems, services for urban land development and redevelopment, and solid waste management.

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IBI is a group of companies practising professional consulting and is affiliated with BIA Brisbaker/Irwin Associates Architects, Engineers, Planners

This study breaks new ground by drawing together demand, supply, cost and effectiveness findings for three quite different future urban forms for the entire GTA including both "hard" and "soft" infrastructure. There is, therefore, little precedent against which to assess the results, some of which are perhaps unexpected or at least thought-provoking. The results are therefore preliminary, for discussion. If, as the findings are scrutinized and the comparison ratings are discussed, a consensus emerges regarding a preferred future urban structure for the GTA and/or process for moving purposefully in that direction, the study will have served its purpose.

The opinions offered herein are those of the consulting team and do not necessarily reflect the views of the Subcommittee or governments associated with the GTA Urban Structure Concepts Study which we are currently carrying out on your behalf.

We trust that the information and opinions offered will be helpful in the context of the study and subsequent planning activities and decisions.

Yours sincerely,

IBI GROUP

Neal A. Irwin
Managing Director

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Director

NAI:mr

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Greater Toronto Area Urban Structure Concepts Study: Background Report No. 4: Water, Sewers and Solid Waste: Executive Summary

This background report describes the comparison of hard services for the three urban structure concepts. Hard services are defined as include the trunk water and sanitary sewerage systems, local services for urban land development and redevelopment, and solid waste management.

TRUNK, WATER AND SANITARY SEWERAGE SYSTEMS

The estimated capital costs ($ million, 1990) for expanding the trunk water and sanitary sewerage systems to the year 2021 are as follows:

Concept	Water	Sanitary Sewerage	Totals
1, Spread	1,800	1,825	3,625
2, Central	1,650	1,670	3,320
3, Nodal	1,740	1,750	3,490

The differences among these estimated costs are not significant. The similarity of the costs is due to a number of factors including:

- essentially, the same treatment capacity is required in each concept and water treatment and sewage treatment represent about two-thirds of the costs;
- there is residual capacity in certain elements of the systems including the existing water intakes at the water treatment plants, and the trunk sanitary sewerage system in the Region of Peel;
- the main cost differences relate to the local water/sewer and road systems as discussed under land development costs below:

LAND DEVELOPMENT COSTS

The following table summarizes the estimates of land development areas and costs by concept.

Development Areas (acres)	Concept 1, Spread	Concept 2, Central	Concept 3, Nodal
New Residential	189,100	65,900	114,400
New Industrial	34,000	21,400	32,200
Redevelopment	2,750	11,000	4,750
Development Costs ($ millions)			
New Residential	13,237	4,613	8,008
New Industrial	1,700	1,070	1,610
Redevelopment	825	3,300	1,425
Total	15,762	8,983	11,043

These cost estimates include the grading of the development areas, installation of local water and sewer services, storm water management, and installation of local electric power service, street lighting, streets and sidewalks. The estimates do not provide for difficult soils conditions and the disposal of contaminated soils.

SOLID WASTE MANAGEMENT

It was found that solid waste disposal costs do not vary significantly among the urban structure concepts. The analysis demonstrates that the type of system used e.g. centralized versus decentralized or a combination of both, will be a major determinant of future costs.

COMPARISON MEASURES

As shown in Exhibit 7, the concepts are given equal ratings in terms of the cost of trunk water and sanitary sewerage systems and solid waste management. Concept 2: Central is given a high rating for the land development/redevelopment factor because of its relatively low capital cost. Concept 3 is given a medium-high rating on this factor and Concept 1 is assigned a low rating.

Greater Toronto Area Urban Structure Concepts Study: Background Report No. 4: Water, Sewers and Solid Waste

1. INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this background report is to describe the analysis of hard services which was carried out as part of the Urban Structure Concepts Study. This study was carried out during the period February - June 1990 on behalf of the Greater Toronto Coordinating Committee.

The general objective of the Urban Structure Concepts Study is to develop three generic urban structure concepts for the Greater Toronto Area (GTA) and to provide a broad, strategic comparison of the three concepts with particular emphasis on their infrastructure requirements (e.g. transportation, hard services, human services, open space) and the capital costs of such facilities, as well as impacts on the immediate hinterland of the GTA. It is important to emphasize that this is not a planning study, in that none of the three concepts is being put forward as a recommended plan. Rather, each of the concepts is a case study, postulated in order to examine the infrastructure and related functional and quality aspects of three quite different urban structure possibilities for the GTA.

With respect to services (water, sewers and solid waste) the terms of reference stated:

> "The servicing needs of each option would be assessed on the basis of growth. Alternatives where multi-regional growth can be handled collectively would be considered."

This background report compares the three urban structure concepts on the basis of the costs of expanding trunk water and sewerage systems, the local servicing of land development and redevelopment areas, and solid waste management costs.

1.2 STUDY TEAM

The analysis was carried out by IBI Group in association with R. V. Anderson Associates Ltd., MacViro Consultants Inc. and Totten, Sims, Hubicki Associates. The specific responsibilities of these sub-consultant firms were as follows:

- R.V. Anderson Associates Limited: trunk water and sewer cost estimates for the Regions of Peel and Halton;

- MacViro Consultants Inc.: estimates of trunk water costs for Metropolitan Toronto and the Region of York, trunk sanitary sewerage cost estimates for the Region of York and solid waste disposal for the GTA;

- Totten, Sims, Hubicki Associates: trunk sanitary sewerage cost estimates for Metropolitan Toronto and the Region of Durham, and trunk water cost estimates for the Region of Durham.

Because of the close relationship with Background Report No. 5: Greening/ Environment, Bruce Brown Associates Ltd. participated in an advisory capacity in the analyses of trunk water and sewer costs and solid waste management considerations.

1.3 OVERVIEW OF URBAN STRUCTURE CONCEPTS

In accordance with the terms of reference, the three urban structure concepts were developed following the prescribed guidelines:

1. A status quo concept, representing a continuation of existing trends, characterized by substantial population growth in the suburban regions at relatively low density, with continuing concentration of office development downtown and in various sub-centres in Metro and the four adjacent regions (designated as **Concept 1, Spread**);

2. A concept in which substantial additional population growth/intensification occurs within Metro Toronto, and other "mature" urbanized areas adjacent to Metro along with further intensification of employment activities such that the rate of urbanization occurring beyond Metro boundaries would be significantly reduced (referred to as **Concept 2, Central**); and

3. An intermediate concept in which residential and employment growth occurs primarily in and around various existing communities in a compact form, resulting in reduced consumption of undeveloped land relative to Concept 1 (referred to as **Concept 3, Nodal**).

Exhibit 1 shows the actual distribution of population and employment by region in the base year (1986) and the postulated distribution for each of the future years (2011 and 2021) for Concepts 1, 2 and 3. Also shown in each instance are the ratio of total employment to

EXHIBIT 1

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GTA Urban Structure Concepts: Overview of Population and Employment Distributions by Region

	DURHAM		HALTON		METRO		PEEL		YORK		GTA TOTAL	
BASE YEAR (1986)												
Resident Population, P (000's)	326		271		2193		592		351		3733	
Total Employment, E (000's)	137		119		1349		304		170		2079	
Activity Rate (E/P)	0.420		0.439		0.615		0.514		0.484		0.557	
Urbanized Area (000's of acres)	49.2		45.4		152.9		74.1		54.8		376.4	
Gross Density ([P+E]/Urbanized Area)	9.4		8.6		23.2		12.1		9.5		15.4	
	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021	2011	2021
CONCEPT 1: Spread												
Resident Population, P (000's)	673	794	497	593	2358	2428	1060	1198	851	1007	5438	6020
Total Employment, E (000's)	280	309	244	271	1686	1724	593	631	456	505	3259	3440
Activity Rate (E/P)	0.416	0.389	0.491	0.457	0.715	0.710	0.559	0.527	0.536	0.501	0.599	0.571
Urbanized Area (000's of acres)	87.3	99.3	74.3	84.7	152.9	152.9	119.0	129.3	116.5	133.5	550.0	599.7
Gross Density ([P+E]/Urbanized Area)	10.9	11.1	10.0	10.2	26.4	27.2	13.9	14.1	11.2	11.3	15.8	15.8
CONCEPT 2: Central												
Resident Population, P (000's)	455	475	362	378	3310	3800	794	828	517	540	5438	6020
Total Employment, E (000's)	253	263	203	211	2046	2183	465	479	293	304	3259	3440
Activity Rate (E/P)	0.557	0.554	0.560	0.560	0.618	0.574	0.585	0.578	0.566	0.564	0.599	0.571
Urbanized Area (000's of acres)	68.4	70.8	59.6	61.7	152.9	152.9	95.5	98.3	77.4	80.1	453.8	483.8
Gross Density ([P+E]/Urbanized Area)	10.4	10.4	9.5	9.5	35.0	39.1	13.2	13.3	10.5	10.5	19.2	20.4
CONCEPT 3: Nodal												
Resident Population, P (000's)	595	681	464	545	2626	2800	1050	1190	703	804	5438	6020
Total Employment, E (000's)	288	312	240	266	1748	1794	600	651	383	417	3259	3440
Activity Rate (E/P)	0.484	0.458	0.517	0.488	0.666	0.641	0.571	0.547	0.545	0.519	0.599	0.571
Urbanized Area (000's of acres)	77.4	84.7	63.5	69.4	152.9	152.9	109.9	118.4	88.0	96.4	491.7	521.8
Gross Density ([P+E]/Urbanized Area)	11.4	11.7	11.1	11.7	28.6	30.0	15.0	15.5	12.3	12.7	17.7	18.1

Note: Concept 1 is the GTCC "Base Case" Projection.

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residential population in each region, referred to in this presentation as the activity rate, and estimates of the urbanized area and gross urban density for each concept.

The source of the base year numbers is the 1986 Census and the reports prepared by Clayton Research Associates Ltd. and Hemson Consulting Ltd. for the Greater Toronto Coordinating Committee (GTCC) in October, 1989. The source for the Concept 1 figures is the Clayton and Hemson reports taking the "base case" projections prepared for the GTCC.

As indicated in Exhibit 1, the resident population in the GTA was about 3.7 million in 1986. Based on the GTCC projections, the resident population is expected to rise to about 6 million people by the year 2021, an increase of some 2.3 million people over the 35 year period between 1986 and 2021. Similarly, total employment in the GTA is projected to rise from about 2 million jobs in 1986 to 3.4 million jobs by the year 2021, an increase of some 1.4 million jobs over the 35 year period.

Concepts 1, 2 and 3 are illustrated in Exhibits 2, 3 and 4 respectively.

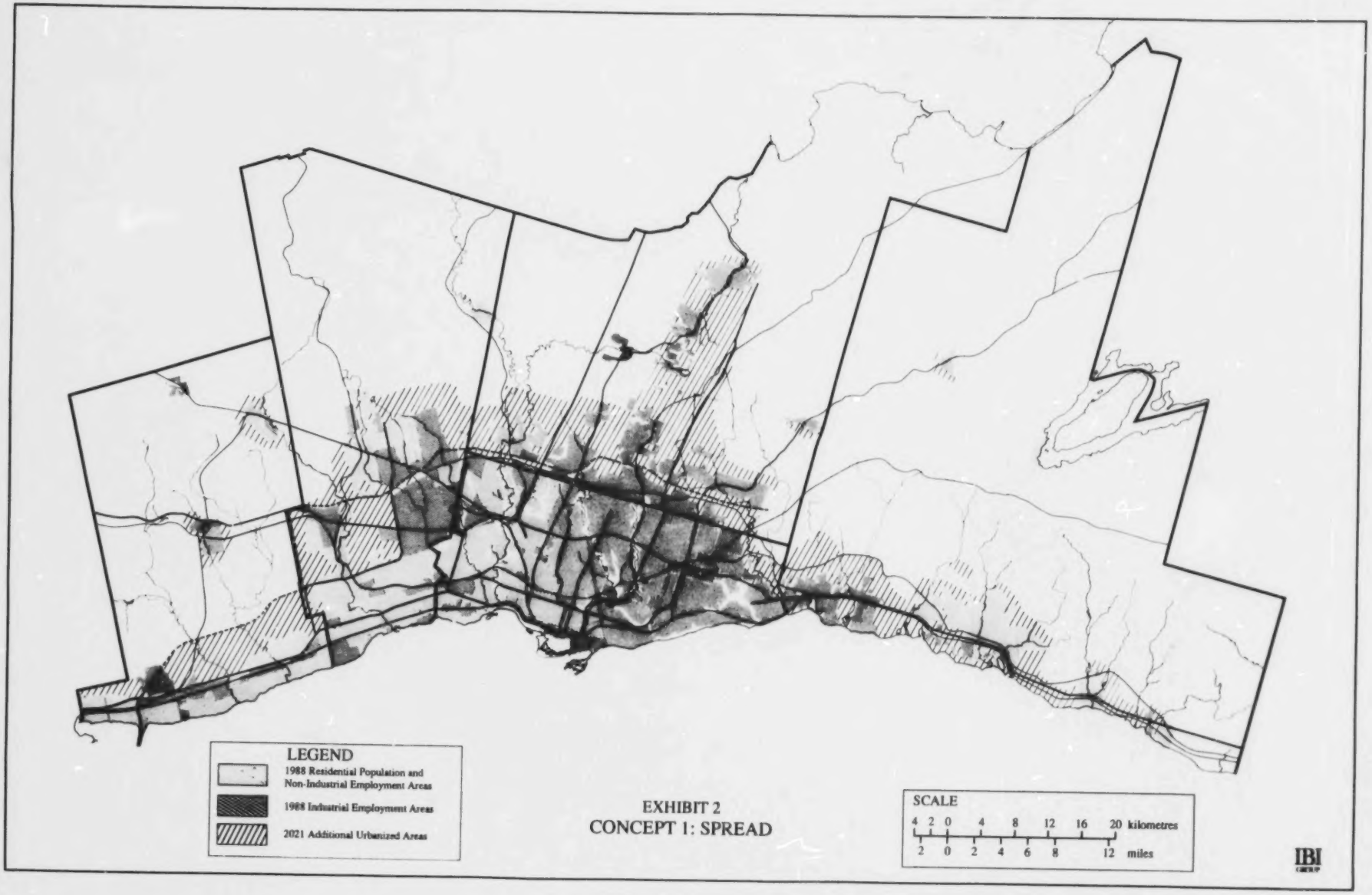
LEGEND
1988 Residential Population and Non-Industrial Employment Areas
1988 Industrial Employment Areas
2021 Additional Urbanized Areas
SCALE
4 2 0 4 8 12 16 20 kilometres
2 0 2 4 6 8 12 miles
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EXHIBIT 2
CONCEPT 1: SPREAD

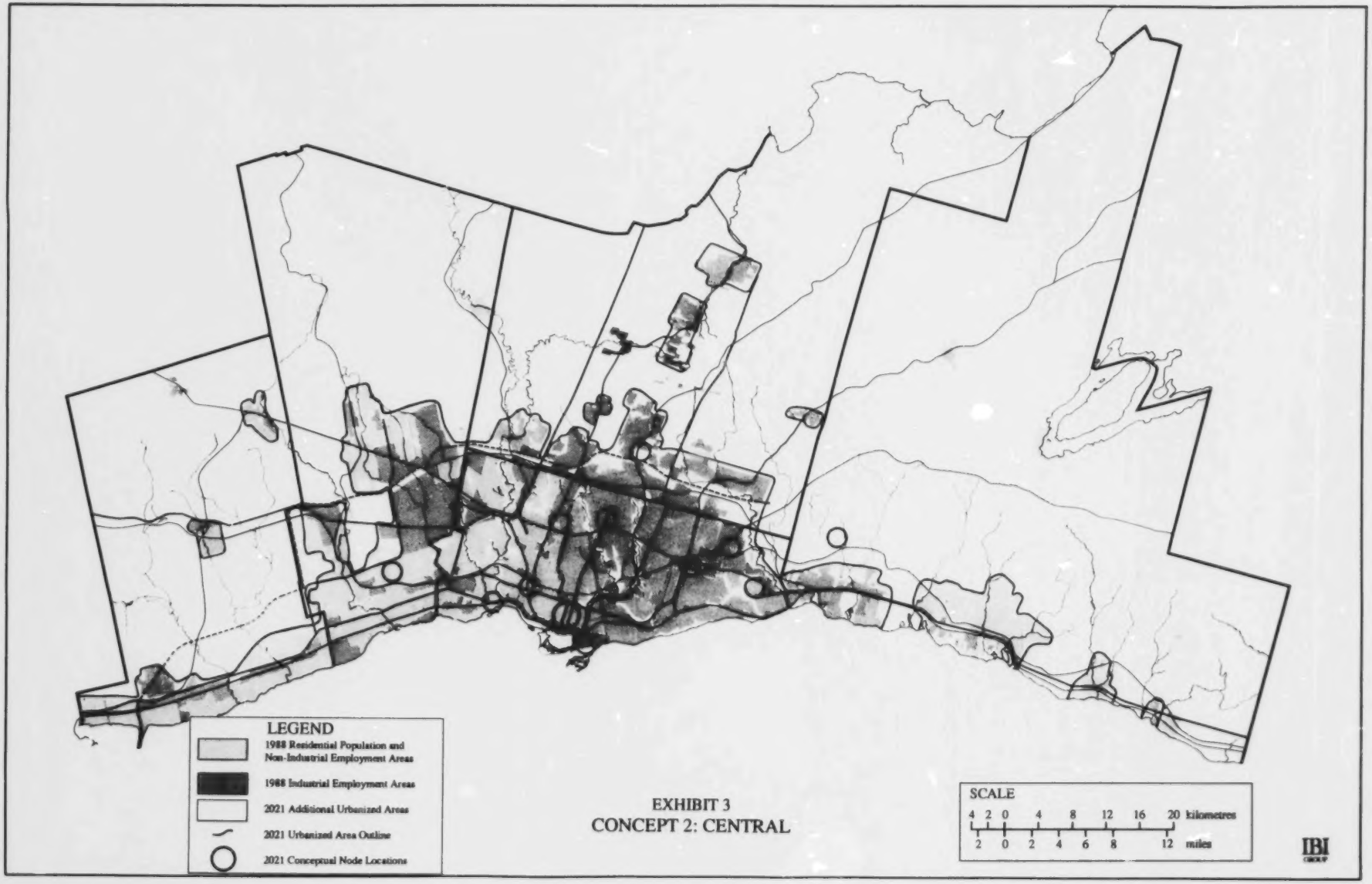
LEGEND
1988 Residential Population and Non-Industrial Employment Areas
1988 Industrial Employment Areas
2021 Additional Urbanized Areas
2021 Urbanized Area Outline
2021 Conceptual Node Locations
SCALE
4 2 0 4 8 12 16 20 kilometres
2 0 2 4 6 8 12 miles
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EXHIBIT 3
CONCEPT 2: CENTRAL

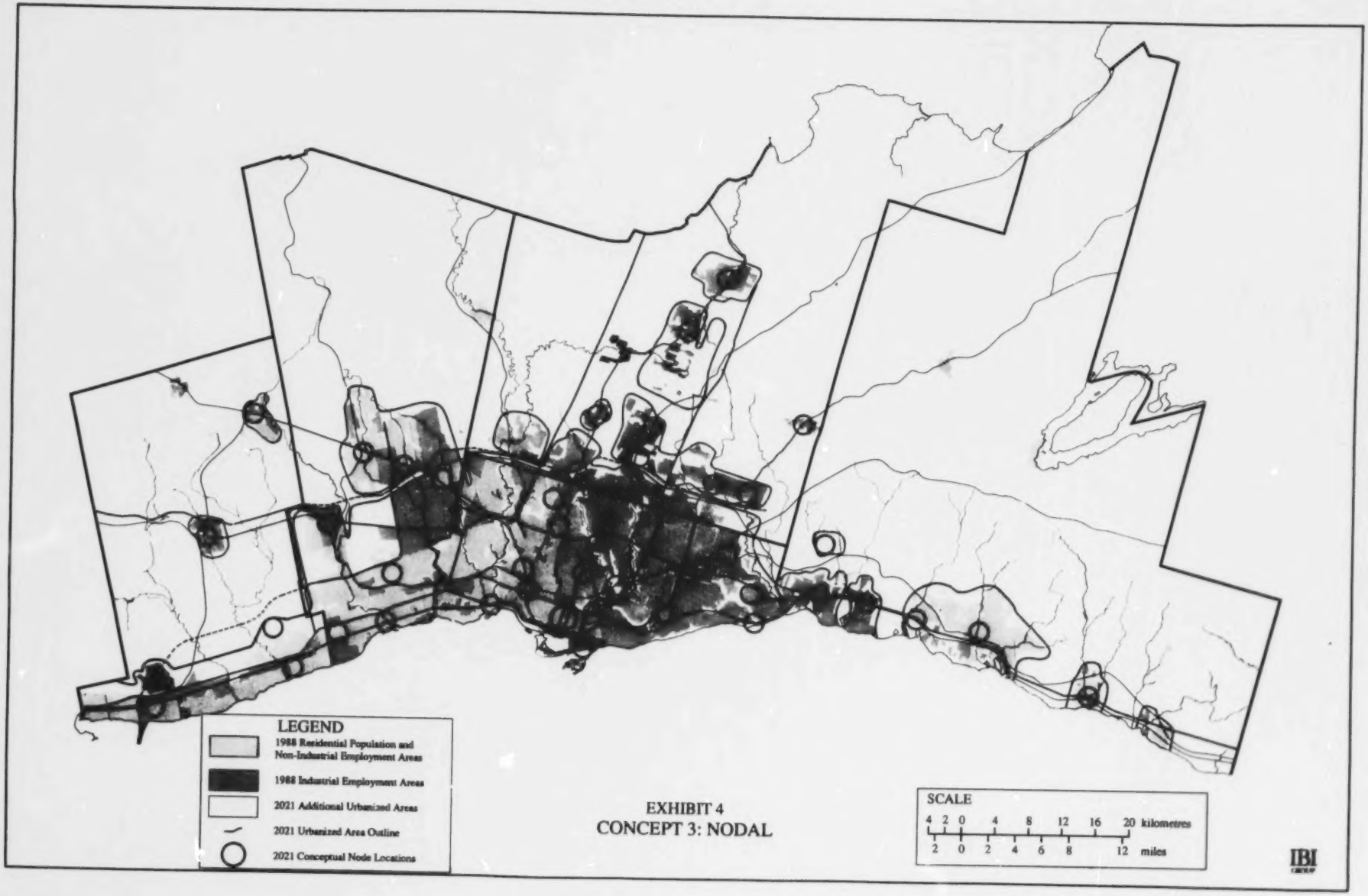
LEGEND
1988 Residential Population and Non-Industrial Employment Areas
1988 Industrial Employment Areas
2021 Additional Urbanized Areas
2021 Urbanized Area Outline
2021 Conceptual Node Locations
SCALE
4 2 0 4 8 12 16 20 kilometres
2 0 2 4 6 8 12 miles
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EXHIBIT 4
CONCEPT 3: NODAL

2. WATER SUPPLY AND DISTRIBUTION

2.1 EXISTING SYSTEMS

The main features of the existing water supply and distribution systems are shown in Exhibit 5. The existing built up area is supplied from a number of water treatment plants along the Lake Ontario shoreline. Ground based water supply systems serve all of the areas north of the existing urban envelope except in the Lake Simcoe area where there are three water treatment plants.

The Regional Municipalities of Durham, Halton and Peel operate their own lake-based water supply systems. The built-up area of the Region of York is supplied through the Metropolitan Toronto water system.

Essentially, the systems operate on a user-pay basis, although user charges do not necessarily reflect the full cost of building and operating the various systems.

2.2 BASIS OF COST ESTIMATES

The potential costs of expanding the water supply and distribution systems for each of the three urban structure concepts were estimated based on the following:

- the distribution of population and employment in 2021 as summarized in Exhibit 1;
- the current planning and design standards of the Ministry of Environment and the regional municipalities;
- the actual costs being experienced on major water system expansion projects in the GTA.

Water system requirements for each concept were generally determined by allocating the 2021 population and employment distributions for each concept into boundaries defined for each pressure district. New water demands were applied and total water supply demands for each district were calculated to permit total supply, storage and pumping needs to be defined.

The cost estimates are in $ 1990. They are based on current per-unit costs for such systems and cover all development costs including:

- surveys and mapping;

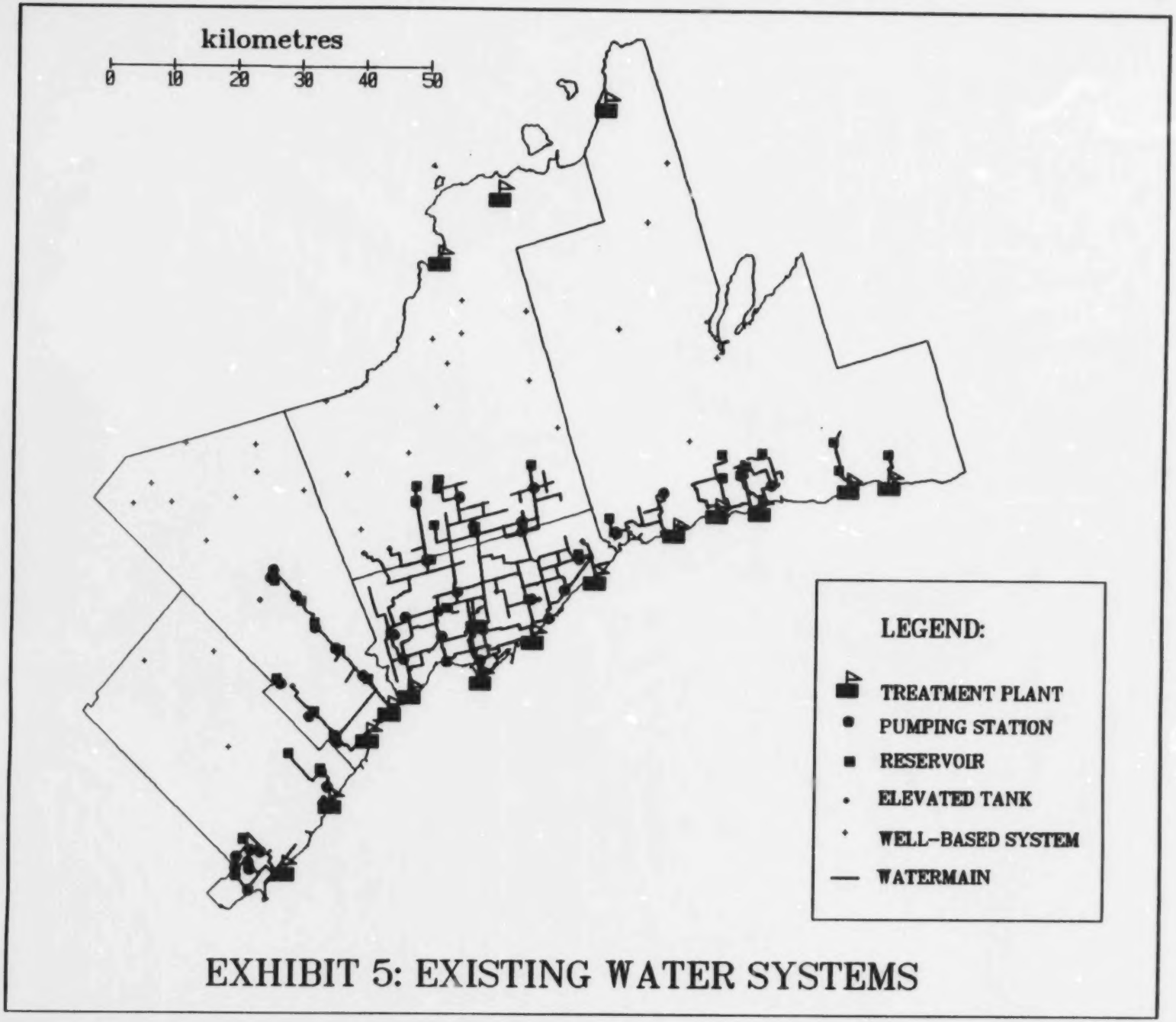

EXHIBIT 5: EXISTING WATER SYSTEMS

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- geotechnical investigations;
- preliminary design and environmental assessment;
- design;
- contract administration and general review during construction;
- resident services during construction;
- construction;
- inspection and testing;
- all applicable taxes and duties.

The cost estimates for both the water and sewer systems, as presented herein, were prepared at a pre-engineering level and are not based on detailed planning or design studies. They are therefore subject to change on an overall basis (generally in the range of ± 30%) based on subsequent, more detailed work, and should be used only for broad, strategic purposes.

2.3 CONCEPT COMPARISON: WATER SUPPLY AND DISTRIBUTION COSTS

Based on the analyses carried out by the three sub-consultants the total estimated capital costs ($ million) of expanding the water system to meet the year 2021 requirements are as follows:

- Concept 1, Spread 1,800
- Concept 2, Central 1,650
- Concept 3, Nodal 1,740

The differences among these estimated costs are not considered significant since they are within the accuracy range of the estimates.

The similarity of the capital cost estimates among the concepts is due to a number of factors including the following:

- essentially the same water treatment capacity is required in each concept because the total GTA population and employment projections are the same in all concepts; water

treatment costs represent about 2/3 of the water system expansion costs in each concept;

- there is residual capacity in some elements of the existing system e.g. the water intakes at each plant are essentially adequate for 2021;

- the main cost differences relate to local servicing systems as discussed in Section 4.

It should be noted that the analyses of the water systems were aimed at identifying representative costs for the expansion of the systems in each concept. The estimates do not represent "least cost" or "optimum" solutions. Various factors will affect the actual costs that are experienced in the future including, for example, measures aimed at conserving the use of water.

For example, the recent announcement by the Treasurer of Ontario that a provincial crown corporation will be set up to act as a utility, in conjunction with the private sector, to deliver water supply systems and services, suggests that water rates charged to consumers could eventually increase (by as much as 40%) to reflect the full costs of such systems and services. If this were to occur, it is likely that at least some consumers would take steps to reduce their water consumption (e.g. through water saving shower heads, smaller toilet reservoirs, less lawn watering). While it is difficult to quantify the impacts of such water conserving measures it is possible that, over time, per capita consumption rates might be reduced.

3. SANITARY SEWERAGE SYSTEMS

3.1 EXISTING SYSTEM

The main features of the existing sanitary sewerage systems in the GTA are illustrated in Exhibit 6. As indicated, the built-up areas of the GTA are serviced by water pollution control plants along the Lake Ontario shoreline. Communities that are not in close proximity to these lake based systems are served by local stream based plants, e.g. Georgetown and Milton.

At present, small quantities of the sanitary sewage flows from the Region of York are directed through the Metropolitan Toronto system but most of the Region of York flows are handled through the York-Durham system. Otherwise the systems in each region are basically self contained except near the regional boundaries where there is some overlapping; e.g. flows from the south western area of Etobicoke are directed to the Peel system.

3.2 EXISTING CONSTRAINTS

There are major capacity constraints in the existing sanitary sewerage systems in Metropolitan Toronto, specifically in the Black Creek and Don River sewersheds. The Metropolitan Toronto Works Department has initiated pre-design studies and environmental assessments for relief sewers to serve these areas. At present, urban development in these areas is constrained by the lack of sewer capacity.

Metro Works is also investigating the introduction of a sewer development charge to fund the relief sewers. A study by the Coopers & Lybrand Group entitled "Proposed Cost Sharing for Needed Trunk Sewer Infrastructure" April 24, 1990 has been released. The study proposes a Metro-wide development charge of $17.20/square metre of new residential space and $13.28/square metre of new non-residential space to fund the estimated $435 million of required improvements. These improvements include the proposed Keele Street relief sewer and the provision of additional capacity in the Don sanitary sewerage system.

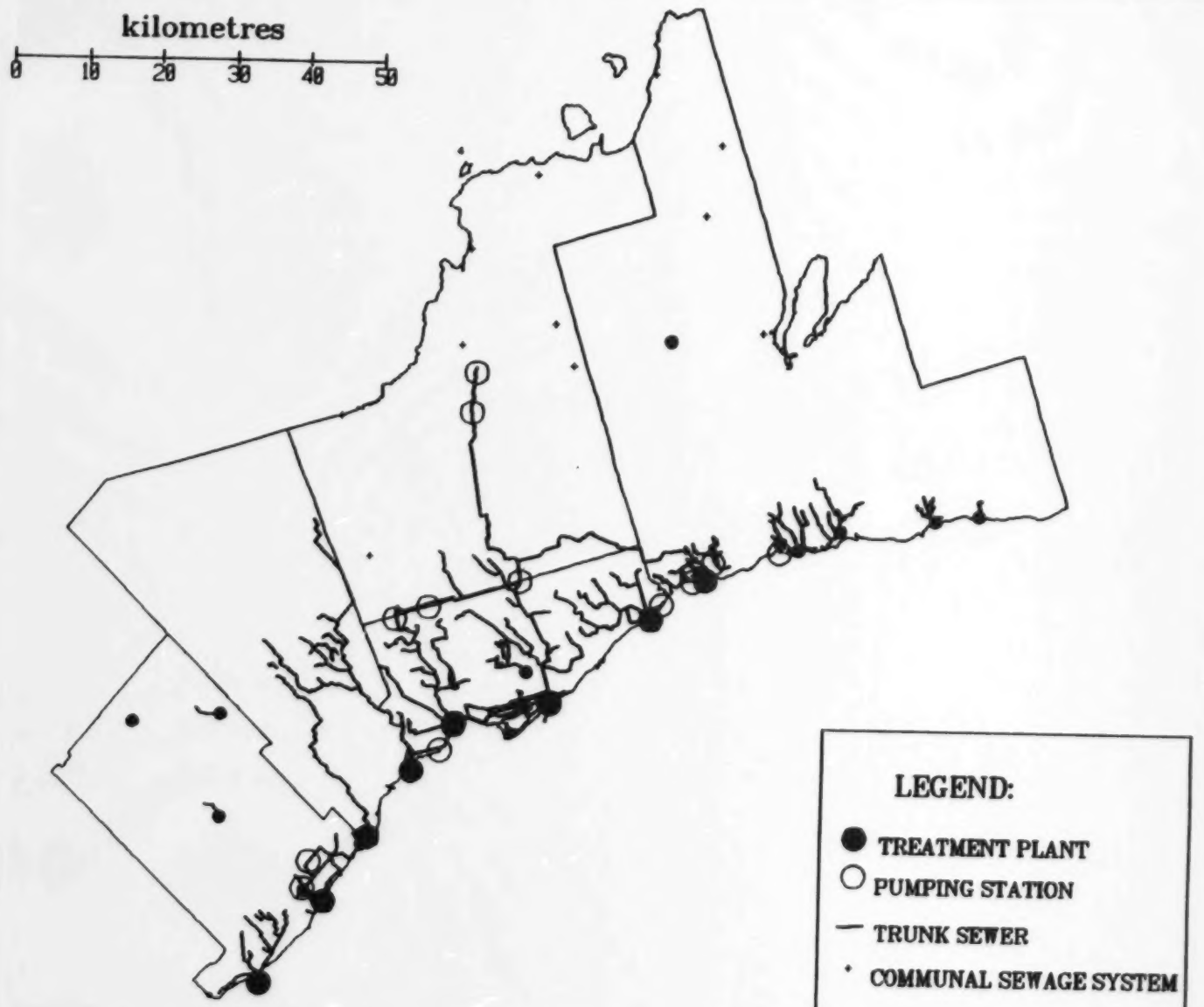

EXHIBIT 6: EXISTING SANITARY SEWERAGE SYSTEMS

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3.3 BASIS OF COST ESTIMATES

The cost estimates for the sanitary sewerage expansion in each concept were developed using an approach similar to that described in Section 2 above. The population and employment distributions for the concepts were allocated to the drainage areas for each trunk system and sanitary sewage flows were estimated using the planning and design criteria employed by each regional municipality. The cost estimates are based on normal per-unit costs and on recent experience for major sanitary projects in the GTA and the prevailing standards of the Ministry of Environment and the regional municipalities.

It should be noted that the cost estimates represent a basic level of service involving the continuation and extension of current programs in order to meet future capacity requirements. In the future, existing standards may be upgraded to improve the quality of the natural environment e.g. a possible requirement for tertiary treatment at sewage treatment plants. The potential costs associated with such measures are discussed in Section 3.5.

3.4 CONCEPT COMPARISON: SANITARY SEWERAGE COSTS

The estimated capital costs ($ million) for expanding the sanitary sewerage system to the year 2021 are as follows:

- Concept 1, Spread 1,920
- Concept 2, Central 2,030
- Concept 3, Nodal 1,940

The differences among the estimates are marginal and are not significant. Accordingly, it is concluded that the three concepts have generally the same capital cost implications in terms of the requirements for the expansion of sanitary sewerage systems.

The similarity of the capital cost estimates is due to a number of factors including the following:

- sewage treatment capacity is essentially the same across the concepts and sewage treatment represents about 2/3 of the expansion costs;
- there is some residual capacity in the existing system e.g. the Region of Peel trunk system has significant built-in capacity for meeting future needs;

- the main cost differences relate to local servicing costs as discussed in Section 4.

As in the case of the water systems, the analyses of the sanitary sewerage systems were aimed at identifying representative costs for the expansion of the systems in each concept. The estimates do not represent "least cost" or "optimum" solutions. Various factors will affect the actual costs that are experienced including measures aimed at conserving water use and reducing the associated volume of sanitary sewage.

3.5 ENHANCED STANDARDS

The Metro Toronto Remedial Actron Plan (RAP) is being undertaken by Environment Ontario and Environment Canada in consultation with the public. The RAP is expected to be completed by the winter, 1991.

A draft Discussion Paper on Remedial Options was released in April 1990 by the Metro Toronto RAP team. That paper includes order of magnitude capital cost estimates for a range of measures aimed at improving water quality in the Metro Toronto area. While these cost estimates cannot be readily extrapolated to cover the entire GTA, they do provide an indication of the future investment levels required to achieve significant improvement of water quality. The major cost items include:

• tertiary treatment at Metro sewage treatment plants	$600 million
• elimination of combined sewer overflows (over and above the sanitary sewerage costs cited in 3.3 above)	$143 million
• Don River water quality	up to $900 million over 10-20 years

It appears that the improvement of water quality throughout the GTA could involve capital expenditures of $2 billion at least given the cost information provided in the Metro Toronto RAP Discussion Paper. It is not possible to determine the extent to which capital expenditures would vary among the three urban structure concepts.

4. LAND DEVELOPMENT COSTS

4.1 UNIT COSTS

The study team reviewed recent land development costs being experienced for new urban development sites and redevelopment projects in the GTA. This review indicated that the average unit costs for land development are generally as follows:

- new residential development $70,000 per acre
- new industrial development $50,000 per acre
- urban redevelopment $300,000 per acre

These average unit costs include grading of the development area, installation of local water and sewer services, storm water management, and installation of local electric power service, street lighting, streets and sidewalks. The unit costs do not provide for difficult soils conditions and the disposal of contaminated soils. Such costs can vary significantly from site to site. Also, the costs do not include provision for gas and telephone lines; these services are installed separately at no charge to the developer. Gas distribution costs are discussed in Section 4.3.

Land development costs vary with density and location. For example residential development costs in suburban locations generally range from $50,000 to $80,000 per acre with the upper end of the range representing densities of 7 lots per acre.

Urban redevelopment costs are much higher on a per-acre basis than suburban land development costs. The higher costs are due to a number of factors including the smaller, more confined sites involved, the need to maintain traffic and transit operations through the redevelopment sites, the demolition of existing structures, and the age and condition of existing underground services. Urban redevelopment construction is quite different in scope to suburban "greenfield" construction.

4.2 DEVELOPMENT AREAS AND COSTS

Estimates of the land development areas were derived from the information presented in Background Report No. 1: Description of Urban Structure Concepts. In estimating the amount of urban redevelopment it was assumed that the redevelopment area would be generally proportional to the increase in population and employment in the older built-up areas, particularly in Metro Toronto.

The following table summarizes the estimates of land development and costs by concept.

	Concept 1 Spread	Concept 2 Central	Concept 3 Nodal
Development Areas (acres)			
New Residential	189,100	65,900	114,400
New Industrial	34,000	21,400	32,200
Redevelopment	2,750	11,000	4,750
Development Costs ($ million)			
New Residential	13,237	4,613	8,008
New Industrial	1,700	1,070	1,610
Redevelopment	825	3,300	1,425
Total	15,762	8,983	11,043

These estimates indicate significant differences among the concepts in terms of the investments in land development and redevelopment. Concept 2 is some $6.8 billion less than Concept 1 and $2 billion less than Concept 3.

In general the land development costs represent investments by the private sector but there are some public sector costs involved in terms of land development for new public facilities such as hospitals and colleges and publicly sponsored housing developments. At the conclusion of the development process, the public sector assumes responsibility for the streets and services, except for the separate utility systems such as electric power, natural gas and telephone. Private sector land development costs are generally passed on directly to the owners and tenants of the new residential and employment facilities.

4.3 GAS DISTRIBUTION

Consumers Gas has provided estimates of the costs of supplying gas in the three concepts. Consumers Gas supplies customers in four of the five Regional Municipalities that comprise the GTA.

In a letter from Consumers Gas the following unit costs were identified:

- Concept 1, Spread $560,000 per 1,000 people
- Concept 2, Central $488,000 per 1,000 people
- Concept 3, Nodal $513,000 per 1,000 people

In the letter it is noted that these are broad estimates and do not reflect possible changes in the mix in the industrial/commercial market and the decline in household size.

Applying these unit costs to the population increase of 2.0 million people estimated for the period 1990 - 2021 yields the following cost estimates for gas distribution:

- Concept 1, Spread $1,120 million
- Concept 2, Central $ 976 million
- Concept 3, Nodal $1,026 million

These estimates follow a pattern similar to the land development cost estimates but with much less variation among the three concepts. They were not included in the total land services costs because they represent only part of the energy utility costs for the GTA, the remainder of these costs were not readily available, and the anticipated differences in costs among the concepts are small.

4.4 BUILDING COSTS

Building development costs were estimated using the 2021 population and employment projections as shown below:

	Residential	Industrial	Non-Industrial
Floorspace/person (sq.ft.)	500	500	300
Unit Construction Cost ($ sq.ft.)	75	60	85

Increase of Population/ Employment ('000)	2,000	467	724
Increase in floor space (millions of square feet)	1,000	234	217
Building Costs ($ million)	75,000	14,040	18,445

Based on the above, some 1451 million square feet of additional building floorspace would be required to accommodate the projected increase in population and employment from 1990 to 2021. The cost of developing this amount of space would be in the order of $108 billion. Differences among the concepts for developing this amount of space would likely be small but are difficult to estimate reliably. These cost estimates are therefore not included in the total capital cost estimates for the three concepts, but are included here to illustrate the relative magnitude of building costs over the 1990 - 2021 period.

5. SOLID WASTE MANAGEMENT

MacViro Consultants Inc. estimated the potential solid waste disposal costs for each urban structure concept. Two systems were included in this analysis: a centralized system which presents economies of scale in terms of processing; and a decentralized system which presents economies in haul costs.

The results of this analysis are summarized below:

Annual 2011 System Costs ($ million, 1990)	Concept 1, Spread	Concept 2, Central	Concept 3, Nodal
Centralized System			
Collection	147	144	146
Haul	54	52	53
Processing/Disposal	497	496	497
Total	697	693	696
Decentralized System			
Collection	147	144	146
Haul	13	13	13
Processing/Disposal	745	745	745
Total	906	902	904

Based on this analysis, it is concluded that the three urban structure concepts do not vary significantly in terms of the cost implications of solid waste disposal. It is also clear that the choice of the type of system (centralized, decentralized or a combination of both) will be a major determinant of future costs.

It should be noted that the quantities of surplus earth and fill generated by urban development are of the same order of magnitude as the quantities of solid waste. With tightening environmental regulations alternative disposal and treatment approaches will be required as a significant amount of the earth and fill is contaminated. Concept 2, Central would involve more urban redevelopment than the other two concepts and would generate larger quantities of materials requiring either on-site treatment or off-site disposal.

Concept 1, Spread would generate the lowest quantities of such materials. These considerations are discussed in Background Report No. 5: Greening/Environment.

6. OVERALL HARD SERVICES COMPARISON OF CONCEPTS

This section of the background report is structured in accordance with the relevant criteria and factors presented in the Comparison Measures Table in the GTA Urban Structure Summary Report and in Background Report No. 7: Comparison of Urban Structure Concepts. The relevant criteria and factors are as follows:

4.1 Capital costs of expanding trunk water and sanitary sewerage systems;

4.2 Capital and operating costs of solid waste disposal systems;

4.3 Capital site-related hard services costs for land development and redevelopment.

The application of these criteria and factors based on the information in this Background report is described below.

A summary of the comparison is presented in Exhibit 7.

6.1 FACTOR 4.1: TRUNK WATER AND SANITARY SEWERAGE SYSTEMS

The comparison measure for this factor is the estimated total capital cost of providing trunk water and sanitary sewerage capacity to meet the requirements of each concept. The cost estimates ($ million) provided in sections 2 and 3 are summarized below:

Component	Concept 1, Spread	Concept 2, Central	Concept 3 Nodal
Water	1,800	1,650	1,740
Sanitary sewerage	1,920	2,030	1,940
Total	3,720	3,680	3,680

It is apparent that there are no significant differences among the concepts in terms of the capital costs for trunk water and sanitary sewerage systems. Accordingly, each concept is given a **medium** rating as shown in Exhibit 7.

EXHIBIT 7
GTA URBAN STRUCTURE CONCEPTS STUDY
COMPARISON MEASURES TABLE
4. HARD SERVICES

CRITERIA & FACTORS	COMPARISON MEASURES	CONCEPT 1: SPREAD CITY	CONCEPT 2: INTENSIFIED/CENTRAL	CONCEPT 3: COMPACT/NODAL
4.1 Trunk water and sanitary sewerage systems	**Low capital costs to expand trunk water and sewerage systems**	**Medium:** Estimated capital cost is $3.7 billion	**Medium:** Estimated capital cost is $3.7 billion	**Medium:** Estimated capital cost is $3.7 billion
4.2 Solid waste management	**Low costs to provide and operate solid waste disposal systems**	**Medium:** Relative life cycle costs are essentially the same in the three concepts: $5.9 billion for centralized waste management system; $7.7 billion for decentralized system.	**Medium:** Relative life cycle costs are essentially the same in the three concepts: $5.9 billion for centralized waste management system; $7.7 billion for decentralized system.	**Medium:** Relative life cycle costs are essentially the same in the three concepts: $5.9 billion for centralized waste management system; $7.7 billion for decentralized system.
4.3 Land development and redevelopment	**Low capital costs for land development and redevelopment, site preparation and local services**	**Low:** Estimated capital cost is $15.8 billion	**High:** Estimated capital cost is $9.0 billion	**Medium-High:** Estimated capital cost is $11.0 billion

Note: These costs are based on existing standards for water quality and sewage treatment plant effluent.
See Background Report 5: Greening/Environment regarding the implications and costs of enhanced standards.

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6.2 FACTOR 4.2: SOLID WASTE MANAGEMENT

The cost estimates ($ million) for solid waste management described in Section 5 are summarized below.

The costs shown are annual 2011 system costs ($ million, 1990).

Assumption	Concept 1, Spread	Concept 2, Central	Concept 3, Nodal
Centralized System	697	693	696
Decentralized System	906	902	904

There is little difference among the concepts in terms of solid waste management costs. The type of system used (i.e. centralized, decentralized, or other) is the key determinant of costs.

Accordingly, the concepts are considered to be equal in relation to this factor and are all given a **medium** rank in Exhibit 7.

6.3 FACTOR 4.3: LAND DEVELOPMENT AND REDEVELOPMENT

The estimated costs of land development and redevelopment from section 5 are summarized below:

- Concept 1, Spread $15.8 billion
- Concept 2, Central $ 9.0 billion
- Concept 3, Nodal $11.0 billion

On this basis Concept 2 is given a **high** ranking in Exhibit 7, Concept 3 is given a **medium-high** ranking and Concept 1 a **low** ranking.